Designation: B422/B422M – 17

Standard Specification for Copper-Aluminum-Silicon-Cobalt Alloy, Copper-Nickel-Silicon-Magnesium Alloy, Copper-Nickel-Silicon Alloy, Copper-Nickel-Aluminum-Magnesium Alloy, and Copper-Nickel-Tin Alloy Sheet and Strip[1]

This standard is issued under the fixed designation B422/B422M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification establishes the requirements for[2] Copper Alloy UNS Nos. C19002, C19010, C19015, C19020, C19025, C63800, C64725, C70250, C70260, C70265, C70310, and C70350 sheet and strip.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 The following safety hazard caveat pertains only to the test method(s) described in this specification.

1.3.1 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

B248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar

B248M Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar (Metric)

B846 Terminology for Copper and Copper Alloys

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

3. General Requirements

3.1 Material furnished to this specification shall be in accordance with the applicable requirements of the current edition of Specification B248 or B248M.

4. Terminology

4.1 *Definitions*—For definitions of terms related to copper and copper alloys, refer to Terminology B846.

5. Ordering Information

5.1 Include the following specified choices when placing orders for product under this specification, as applicable.

5.1.1 ASTM designation and year of issue.

5.1.2 Copper [Alloy] UNS No. designation (Section 1),

5.1.3 Temper (see 7.1),

5.1.4 Dimensions (thickness, width, length, if applicable),

5.1.5 How furnished (rolls, specific lengths with or without ends, stock lengths with or without ends),

[1] This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.01 on Plate, Sheet, and Strip.

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[2] The UNS system for copper and copper alloys (see Practice E527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix "C" and a suffix "00." The suffix can be used to accommodate composition variations of the base alloy.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

5.1.6 Quantity—total weight or total length or number of pieces of each size,

5.1.7 Form of material (sheet or strip),

5.1.8 Type of edge, if required (slit, sheared, sawed, square corners, rounded corners, rounded edges, or full-rounded edges (see 10.6),

5.1.9 Type of width and straightness tolerances, if required (slit-metal tolerances, square sheared-metal tolerances, sawed-metal tolerances, straightened or edge-rolled-metal tolerances) (Section 10),

5.2 If product is purchased for agencies of the U.S. government, it shall conform to the Supplementary Requirements as defined in Specification B248 or B248M when specified in the contract or purchase order.

6. Chemical Composition

6.1 The material shall conform to the chemical composition requirements prescribed in Table 1 for the copper [alloy] UNS No. designation specified in the ordering information.

6.2 These composition limits do not preclude the presence of other elements. By agreement between the manufacturer and purchaser, limits may be established and analysis required for unnamed elements.

6.3 For alloys in which copper is listed as "remainder," copper is the difference between the sum of results of all elements determined and 100 %. When all the elements in Table 1 for Alloys C19002, C19010, C63800, C64725, C70250, C70260, C70265, C70310, and C70350 are determined, the sum of the results shall be 99.5 % min. When all the elements in Table 1 for Alloy C19025 are determined, the sum of the results shall be 99.7 % min. When all the elements in Table 1 for Alloys C19015 and C19020 are determined, the sum of the results shall be 99.8 % min.

7. Temper

7.1 The standard tempers for products described in this specification are as given in Tables 2-12.

8. Mechanical Property Requirements

8.1 Copper Alloy UNS No. C63800 is a dispersion-strengthened alloy which does not require heat treatment. The annealed and rolled tempers shall conform to the tensile property requirements prescribed in Table 2.

8.2 Copper Alloy UNS No. C70250 is supplied in a mill-hardened, or cold-worked and precipitation heat-treated, or precipitation heat-treated or spinodal heat-treated, 1/2 Hd and stress-relieved tempers. The 0.2 % offset yield strength shall be the standard tests for these tempers and shall conform to the requirements specified in Table 3.

8.2.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.3 Copper Alloys UNS No. C70260 and C70265 are supplied in a mill-hardened temper. The 0.2 % offset yield strength shall be the standard test for the mill-hardened tempers TM00, TM02, TM03, and TM04 and shall conform to the requirements specified in Table 4. The tensile strength shall be the standard test for the mill-hardened temper TM01 and shall conform to the requirements specified in Table 4.

8.3.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.4 Copper Alloy UNS Nos. C19020 and C19025 are supplied in cold-worked, stress-relieved temper. These tempers shall conform to the tensile strength and elongation requirements in Table 5. The 0.2 % offset yield strength shall be the standard test for the mill-hardened tempers and shall conform to the requirements specified in Table 7 and Table 5, respectively.

8.4.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.5 Copper Alloy UNS No. C19010 is supplied in either precipitation heat-treated (TM03 to TM08) tempers, or mill-hardened (H01 to H10) tempers. The 0.2 % offset yield

TABLE 1 Chemical Requirements Composition %

Element	C19002	C19010	C19015	C19020	C19025	C63800	C64725	C70250	C70260	C70265	C70310	C70350
Nickel	1.4–1.7[A]	0.8–1.8	0.50–2.4	0.50–3.0	0.8–1.2	0.20 max.	1.3–2.7[A]	2.2–4.2[A]	1.0–3.0[A]	1.0–3.0[A]	1.0–4.0[A]	1.0–2.5
Silicon	0.20–0.35	0.15–0.35	0.10–0.40	. . .	. . .	1.5–2.1	0.20–0.8	0.25–1.2	0.20–0.7	0.20–0.7	0.08–1.0	0.50–1.2
Lead, max	0.05	. . .	. . .	. . .	. . .	0.05	0.01	0.05	. . .	0.05	0.05	0.05
Iron, max	0.10	. . .	. . .	. . .	0.10	0.20	0.25	0.20	. . .	. . .	0.10	0.20
Zinc	0.04–0.35	. . .	. . .	. . .	0.20 max	0.8 max	0.50–1.5	1.0 max	. . .	0.30 max	2.0 max	1.0 max
Aluminum	. . .	. . .	. . .	. . .	. . .	2.5–3.1	. . .	. . .	. . .	. . .	. . .	. . .
Copper[B]	remainder	remainder	remainder	remainder	remainder	remainder	95.0 min	remainder	remainder	remainder	remainder	remainder
Cobalt	. . .	. . .	. . .	. . .	. . .	0.25–0.55	. . .	. . .	. . .	. . .	. . .	1.0–2.0
Manganese, max	. . .	. . .	. . .	. . .	. . .	0.10	. . .	0.10	. . .	. . .	. . .	0.20
Magnesium	0.01 max	. . .	0.02–0.15	. . .	. . .	. . .	0.20 max	0.05–0.30	. . .	. . .	0.10 max	0.04 max
Tin	0.02–0.30	. . .	. . .	0.30–0.9	0.7–1.1	. . .	0.20–0.8	. . .	. . .	0.05–0.8	1.0 max	. . .
Phosphorus	0.05 max	0.01–0.05	0.02–0.20	0.01–0.20	0.03–0.07	. . .	. . .	. . .	0.01 max	0.01 max	0.05 max	. . .
Calcium	. . .	. . .	. . .	. . .	. . .	. . .	0.01 max	. . .	. . .	. . .	. . .	. . .
Chromium	. . .	. . .	. . .	. . .	. . .	. . .	0.09 max	. . .	. . .	. . .	. . .	. . .
Silver	0.02–0.50	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.02–0.50	. . .
Zirconium	0.005–0.05	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.005–0.05	. . .

[A] Including cobalt.
[B] Including silver.

TABLE 2 Tensile Property Requirements and Approximate Hardness Values for Copper Alloy UNS No. C63800

Temper		Tensile Strength		Elongation in 2 in. [50.8 mm], %	Approximate Rockwell Hardness[A]	
Designation	Name	ksi[B]	MPa[C]		Rockwell B	Superficial 30T
O60	soft anneal	78 max	540 max	37 min	. . .	. . .
O61	annealed	77–87	530–600	27–40	. . .	70–78
H01	¼ hard	90–102	620–705	. . .	92–96	76–80
H02	½ hard	100–112	690–770	. . .	95–98	79–81
H03	¾ hard	105–117	725–805	. . .	97–99	80–82
H04	hard	114–126	785–870	. . .	98–100	81–83
H06	extra hard	118–130	815–895	. . .	99–101	81–83
H08	spring	123–134	850–925	. . .	99–101	82–84
H10	extra spring	130 min	895 min	. . .	100 min	83 min

[A] Hardness values shown apply only to direct determination, not converted values. They are for information only.
[B] ksi = 1000 psi.
[C] See Appendix X1.

TABLE 3 Yield Requirements for Copper Alloy UNS No. C70250

Temper Designation	Yield Strength at 0.2 % Offset	
	ksi[A]	MPa[B]
TM00	65–90	450–620
TM02	83–110	570–760
TM03	95–120	655–825
TR02	80 min	550 min
TH03	65–85	450–585

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 4 Tensile and Yield Requirements for Copper Alloy UNS No. C70260 and C70265

Temper Designation	Yield Strength at 0.2 % Offset	
	ksi[A]	MPa[B]
TM00	65–85	450–585
TM02	90–100	620–690
TM03	95–115	655–795
TM04	100–120	690–825
	Tensile Strength	
Temper Designation	ksi[A]	MPa[B]
TM01	90–105	620–725

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 5 Tensile Requirements for Copper Alloy UNS No. C19025

Designation	Tensile Strength		Elongation in 2 in. [50.8 mm], %
	ksi[A]	MPa[B]	
HR02	63–76	435–525	9–25
HR04	72–83	495–570	5–14
HR06	78 min	540 min	4–12

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 6 Yield Requirements for Copper Alloy UNS No. C19010

Temper Designation	Yield Strength at 0.2 % Offset	
	ksi[A]	MPa[B]
TM03	50–65	345–450
TM04	60–75	415–515
TM06	64–79	440–545
TM08	74–89	510–615
H01	40–55	275–380
H02	54–69	370–475
H03	62–77	430–530
H04	66–81	455–560
H06	72–87	495–600
H08	78–93	540–640
H10	85–100	585–690

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 7 Tensile Requirements for Copper Alloy UNS No. C19020

Designation	Tensile Strength		Elongation in 2 in. [50.8 mm], %
	ksi[A]	MPa[B]	
HR02	58–70	400–485	5 min
HR04	65–74	450–510	3 min
HR06	71–80	490–550	3 min
HR08	77 min	530 min	2 min

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 8 Yield Requirements for Copper Alloy UNS No. C64725

Designation	Yield Strength	
	ksi[A]	MPa[B]
TM02	70–90	485–620
TM04	85–105	585–725
TM06	95–115	655–795
TM08	100–120	690–825
HR04	80–105	550–725

[A] ksi = 1000 psi.
[B] See Appendix X1.

strength shall be the standard test for the precipitation heat-treated and mill-hardened tempers and shall conform to the requirements specified in Table 6.

8.5.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.6 Copper alloy C64725 is supplied in either mill-hardened temper (TM02–TM08) temper, or cold-worked, stress relieved (HR04) temper. Tempers shall conform to the 0.2 % offset yield requirements specified in Table 8.

8.6.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.7 Copper alloy C19002 is supplied in the mill hardened temper (TM04–TM08) temper. Tempers shall conform to the 0.2 % offset yield requirements specified in Table 9.

8.7.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

TABLE 9 Yield Requirements for Copper Alloy UNS No. C19002

Designation	Yield Strength	
	ksi[A]	MPa[B]
TM04	65–75	450–515
TM06	75–85	515–585
TM08	82–92	565–635

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 10 Tensile Requirements for Copper Alloy UNS No. C19015

Designation	Yield Strength	
	ksi[A]	MPa[B]
TM02	53–63	365–435
TM04	60–70	415–485
TM08	68 min	470 min

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 11 Yield Requirements for Copper Alloy UNS No. C70310

Designation	Yield Strength	
	ksi[A]	MPa[B]
TM02	85–110	585–760
TM04	95–120	655–825
TM08	105–130	725–895

[A] ksi = 1000 psi.
[B] See Appendix X1.

TABLE 12 Yield Requirements for Copper Alloy UNS No. C70350

Temper Designation	Yield Strength at 0.2 % Offset	
	ksi[A]	MPa[B]
TM02	98–113	675–780
TM04	109–123	750–850
TM06	117–133	810–920
TM08	127–151	880–1040
TM10	136–160	940–1100

[A] ksi = 1000 psi.
[B] See Appendix X1.

8.8 Copper alloy C19015 is supplied in the mill hardened temper (TM04–TM08) temper. Tempers shall conform to the 0.2 % offset yield requirements specified in Table 10.

8.8.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.9 Copper alloy C70310 is supplied in the mill hardened temper (TM04–TM08) temper. Tempers shall conform to the 0.2 % offset yield requirements specified in Table 11.

8.9.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

8.10 Copper alloy C70350 is supplied in the mill hardened temper (TM02–TM10). Tempers shall conform to the 0.2 % offset yield requirements specified in Table 12.

8.10.1 If ductility or formability requirements are desired, they shall be negotiated and agreed upon between manufacturer and purchaser.

9. Electrical Properties

9.1 The electrical resistivity of Copper Alloys UNS Nos. C19002, C19010, C19015, C19020, C19025, C63800, C64725, C70250, C70260, C70265, C70310, and C70350 are listed in Table 13 for information only.

10. Dimensions and Permissible Variations

10.1 The dimensions and tolerances for product described by this specification shall be as specified in Specification B248 and B248M:

10.2 *Thickness:*

10.3 *Width:*
10.3.1 *Slit Metal and Slit Metal with Rolled Edges*
10.3.2 *Square-Sheared Metal*
10.3.3 *Sawed Metal*

10.4 *Length:*
10.4.1 *Specific and Stock Lengths With and Without Ends*
10.4.2 *Schedule of Lengths (Specific and Stock) With Ends*
10.4.3 *Length Tolerances for Square-Sheared Metal*
10.4.4 *Length Tolerances for Sawed Metal*

10.5 *Straightness:*
10.5.1 *Slit Metal or Slit Metal Either Straightened or Edge-Rolled*
10.5.2 *Square-Sheared Metal*
10.5.3 *Sawed Metal*

TABLE 13 Electrical Resistivity and Conductivity Equivalent

Copper Alloy UNS No.	Temper	Electrical Resistivity at 68 °F [20 °C], Ω · g/m^2	Equivalent Conductivity at 68 °F [20 °C], % IACS
C63800		1.5328	10
C64725	TM02	0.3832	40
C64725	TM04, TM06, TM08, HR04	0.4143	37
C70250	TR02, TM00, TM02	0.3832	40
C70250	TM03	0.4258	36
C70260	TM00, TM02, TM03, TM04	0.3832	40
C70260	TM01	0.3066	50
C70265	TM00, TM02, TM03, TM04	0.4379	35
C70265	TM01	0.3406	45
C19025	HR02, HR04, HR06	0.3832	40
C70250	TH03	0.3066	50
C70310	TM04, TM06, TM08	0.4033	38
C19002	TM04, TM06, TM08	0.3406	45
C19010	H08, H10	0.3193	48
C19010	TM03, TM04, TM06, TM08, H03, H04, H06	0.3066	50
C19010	H01, H02	0.2787	55
C19015	TM04, TM06, TM08	0.2358	65
C19020	HR02, HR04, HR06, HR08	0.3066	50
C70350	TM02, TM04, TM06	0.3208	50
C70350	TM08, TM10	0.3832	40

10.6 *Edges:*
10.6.1 *Square Corners*
10.6.2 *Rounded Corners*
10.6.3 *Rounded Edges*
10.6.4 *Full-Rounded Edges*

11. Keywords

11.1 copper-aluminum-silicon-cobalt alloy; copper-nickel-aluminum magnesium alloy; copper-nickel-silicon alloy; copper nickel-silicon-magnesium alloy; copper-nickel-tin alloy; sheet; strip; UNS No. C19002; UNS No. C19010; UNS No. C19015; UNS No. C19020; UNS No. C19025; UNS No. C63800; UNS No. C64725; UNS No. C70250; UNS No. C70260; UNS No. C70265; UNS No. C70310; UNS No. C70350

APPENDIX

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N = kg \cdot m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since 1 ksi = 6 894 757 Pa, the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2.

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B422/B422M – 15) that may impact the use of this standard.)

(1) Added alloy C70350.